

CLAIMS

What is Claimed is:

1. A system for detecting and analyzing chemical and biological materials in a sample, said system comprising:

a detection device responsive to passive emissions from the sample, said emissions being in the terahertz frequency band, said detection device having a field-of-view and generating an emission spectrum of materials in the sample; and

a cold surface positioned in the field-of-view of the detection device, said cold surface providing a cold background relative to the temperature of the sample.

2. The system according to claim 1 wherein the cold surface includes a terahertz absorber cooled by the group consisting of liquid-helium dewars and cryogenic coolers.

3. The system according to claim 1 wherein the detection device is a Fourier transform spectrometer providing a spectrum analysis of the emissions.

4. The system according to claim 1 further comprising a sample compartment, said sample being confined within the compartment.

5. The system according to claim 1 wherein the sample is within an airborne cloud.

6. The system according to claim 1 further comprising a transmissive substrate, said sample being placed on the transmissive substrate.

7. The system according to claim 6 wherein the transmissive substrate is a plastic window or an anti-reflective coated silicon window.

8. The system according to claim 1 further comprising a filter, said sample being in the filter.

9. The system according to claim 8 wherein the filter is positioned within an air intake vent of a facility.

10. The system according to claim 1 further comprising a container, said sample being contained in the container.

11. The system according to claim 10 wherein the container is selected from the group consisting of an envelope, a cardboard enclosure, a plastic container and a glass container.

12. The system according to claim 1 further comprising an antenna, said antenna collecting the emissions and directing the emissions to the detection device.

13. The system according to claim 12 wherein the antenna is selected from the group consisting of a feed horn and a Cassegrain-type telescope.

14. The system according to claim 1 further comprising a collimator, said collimator focusing the field-of-view of the detection device onto the cold surface.

15. The system according to claim 14 wherein the collimator is a Cassegrain-type telescope.

16. The system according to claim 1 wherein the detection device includes a power splitter and a plurality of detection channels, said power splitter receiving the emissions and directing the emissions into the plurality of channels so that multiple frequency bands can be simultaneously detected.

17. The system according to claim 1 wherein the detection device includes a terahertz receiver for receiving and amplifying signals in the terahertz frequency band.

18. The system according to claim 1 wherein the terahertz frequency band includes microwave, millimeter wave and sub-millimeter wave frequency bands.

19. The system according to claim 1 wherein the sample is selected from the group consisting of a liquid sample, a powder sample, a liquid aerosol sample, a particulate aerosol sample, a bio-aerosol sample, a vapor sample, a gas sample, chemical agents, biological agents, industrial chemicals, toxins, drugs, fungi, pollens, and explosives in the form of vapor, powder, liquid or aerosol.

20. A system for stand-off detecting and analyzing materials in a sample cloud in the air, said system comprising:

a detection device responsive to passive emissions from the sample cloud, said emissions being in the terahertz frequency band, said detection device having a field-of-view and generating an emission spectrum of the materials in the sample cloud; and

a cold surface positioned in the field-of-view of the detection device, said cold surface providing a cold background relative to the temperature of the sample cloud.

21. The system according to claim 20 wherein the cold surface is made of a terahertz absorber cooled by the group consisting of liquid-helium dewars and cryogenic coolers.

22. The system according to claim 20 wherein the detection device is a Fourier transform spectrometer providing a spectrum analysis of the emissions.

23. The system according to claim 20 further comprising a collimator, said collimator focusing the field-of-view of the detection device onto the cold surface.

24. The system according to claim 20 wherein the terahertz frequency band includes microwave, millimeter wave and sub-millimeter wave frequency bands.

25. The system according to claim 20 wherein the sample is selected from the group consisting of a liquid sample, a powder sample, a liquid aerosol sample, a particulate aerosol sample, a bio-aerosol sample, a vapor sample, a gas sample, chemical agents, biological agents, industrial chemicals, toxins, drugs, fungi, pollens, and explosives in the form of vapor, powder, liquid or aerosol.

26. A system for detecting and analyzing chemical and biological materials in a sample, said system comprising:

a compartment for holding the sample, said compartment including a transmission window;

a detection device responsive to passive emissions from the sample transmitted through the transmission window, said emissions being in the terahertz frequency band, said detection device generating an emission spectrum of the materials in the sample; and

a cold surface positioned in the compartment at an opposite side from the detection device, said cold surface providing a cold background relative to the temperature of the sample.

27. The system according to claim 26 wherein the cold surface is made of a terahertz absorber cooled by the group consisting of liquid-helium dewars and cryogenic coolers.

28. The system according to claim 26 wherein the detection device is a Fourier transform spectrometer providing a spectrum analysis of the emissions.

29. The system according to claim 26 further comprising a collimator, said collimator focusing a field-of-view of the detection device onto the cold surface.

30. The system according to claim 26 wherein the terahertz frequency band includes microwave, millimeter wave and sub-millimeter wave frequency bands.

31. The system according to claim 26 wherein the sample is selected from the group consisting of a liquid sample, a powder sample, a liquid aerosol sample, a particulate aerosol sample, a bio-aerosol sample, a vapor sample, a gas sample, chemical agents, biological agents, industrial chemicals, toxins, drugs, fungi, pollens, and explosives in the form of vapor, powder, liquid or aerosol.

32. A system for detecting and analyzing chemical and biological materials in a sample, said system comprising:

a transmission window, said sample being deposited on a surface of the transmission window;

a detection device responsive to passive emissions from the sample, said emissions being in the terahertz frequency band, said detection device having a field-of-view and generating an emission spectrum of the materials in the sample; and

a cold surface positioned in the field-of-view of the detection device, said cold surface providing a cold background relative to the temperature of the sample.

33. The system according to claim 32 wherein the cold surface is made of a terahertz absorber cooled by the group consisting of liquid-helium dewars and cryogenic coolers.

34. The system according to claim 32 wherein the detection device is a Fourier transform spectrometer providing a spectrum analysis of the emissions.

35. The system according to claim 32 further comprising a collimator, said collimator focusing the field-of-view of the detection device onto the cold surface.

36. The system according to claim 32 wherein the terahertz frequency band includes microwave, millimeter wave and sub-millimeter wave frequency bands.

37. The system according to claim 32 wherein the sample is selected from the group consisting of a liquid sample, a powder sample, a liquid aerosol sample, a particulate aerosol sample, a bio-aerosol sample, a vapor sample, a gas sample, chemical agents, biological agents, industrial chemicals, toxins, drugs, fungi, pollens, and explosives in the form of vapor, powder, liquid or aerosol.

38. A system for detecting and analyzing chemical and biological materials in a sample, said system comprising:

a container, said sample being contained in the container;

a detection device responsive to passive emissions from the sample, said emissions being in the terahertz frequency band, said detection device having a field-of-view and generating an emission spectrum of the materials in the sample; and

a cold surface positioned in the field-of-view of the detection device, said cold surface providing a cold background relative to the temperature of the sample.

39. The system according to claim 38 wherein the container is selected from the group consisting of an envelope, a cardboard enclosure, a plastic container and a glass container.

40. The system according to claim 38 wherein the cold surface is made of a terahertz absorber cooled by the group consisting of liquid-helium dewars and cryogenic coolers.

41. The system according to claim 38 wherein the detection device is a Fourier transform spectrometer providing a spectrum analysis of the emissions.

42. The system according to claim 38 further comprising a collimator, said collimator focusing the field-of-view of the detection device onto the cold surface.

43. The system according to claim 38 wherein the terahertz frequency band includes microwave, millimeter wave and sub-millimeter wave frequency bands.

44. The system according to claim 38 wherein the sample is selected from the group consisting of a liquid sample, a powder sample, a liquid aerosol sample, a particulate aerosol sample, a bio-aerosol sample, a vapor sample, a gas sample, chemical agents, biological agents, industrial chemicals, toxins, drugs, fungi, pollens, and explosives in the form of vapor, powder, liquid or aerosol.

45. A system for detecting and analyzing chemical and biological materials in a sample, said system comprising:

a detection device responsive to passive emissions from the sample, said emissions being in the terahertz frequency band, said detection device having a field-of-view and generating an emission spectrum of the materials in the sample, said detection device including a power splitter and a plurality of detection channels, said power splitter receiving the emissions and directing the emissions into the plurality of channels so that multiple frequency bands can be simultaneously detected; and

a cold surface positioned in the field-of-view of the detection device, said cold surface providing a cold background relative to the temperature of the sample.

46. The system according to claim 45 wherein the cold surface is made of a terahertz absorber cooled by the group consisting of liquid-helium dewars and cryogenic coolers.

47. The system according to claim 45 wherein the detection device includes a radiometer in each channel.

48 The system according to claim 45 wherein each radiometer includes a mixer for down-converting the emissions, an intermediate frequency amplifier for

amplifying the down-converted emissions and a diode detector for detecting the amplified and down-converted emissions.

49. The system according to claim 45 further comprising a collimator, said collimator focusing the field-of-view of the detection device onto the cold surface.

50. The system according to claim 45 wherein the terahertz frequency band includes microwave, millimeter wave and sub-millimeter wave frequency bands.

51. The system according to claim 45 wherein the sample is selected from the group consisting of a liquid sample, a powder sample, a liquid aerosol sample, a particulate aerosol sample, a bio-aerosol sample, a vapor sample, a gas sample, chemical agents, biological agents, industrial chemicals, toxins, drugs, fungi, pollens, and explosives in the form of vapor, powder, liquid or aerosol.

52. A system for detecting and analyzing chemical and biological materials in air flowing through an air intake vent of a building, said system comprising:

a filter positioned in the air intake vent where the air flows through the filter so that particles in the air are captured by the filter;

a detection device positioned at one side of the filter and being responsive to passive emissions from the filter, said detection device generating an emission spectrum of materials in the filter; and

a cold surface positioned at an opposite side of the filter from the detection device, said cold surface providing a cold background relative to the temperature of the filter.

53. The system according to claim 52 wherein the cold surface is made of a terahertz absorber cooled by the group consisting of liquid-helium dewars and cryogenic coolers.

54. The system according to claim 52 wherein the detection device is a Fourier transform spectrometer providing a spectrum analysis of the emissions.

55. The system according to claim 52 further comprising a collimator, said collimator focusing the field-of-view of the detection device onto the cold surface.

56. The system according to claim 52 wherein the emissions are in the terahertz frequency band.

57. The system according to claim 52 wherein the sample is selected from the group consisting of a liquid sample, a powder sample, a liquid aerosol sample, a particulate aerosol sample, a bio-aerosol sample, a vapor sample, a gas sample, chemical agents, biological agents, industrial chemicals, toxins, drugs, fungi, pollens, and explosives in the form of vapor, powder, liquid or aerosol.

58. A method for detecting and analyzing chemical and/or biological materials in a sample, said method comprising:

receiving emissions from the sample in a field-of-view of a spectrometer, said emissions being in the terahertz frequency band;

generating an emission spectrum of the materials in the sample in the field-of-view of the spectrometer; and

cooling the background of the sample in the field-of-view of the spectrometer relative to the temperature of the sample.

59. The method according to claim 58 wherein the sample is confined in a sample compartment, concealed in a container, airborne, captured in a filter or placed on a transmissive substrate.

60. The method according to claim 58 wherein the detection device is selected from the group consisting of a Fourier transform spectrometer or a radiometer.

61. The method according to claim 58 wherein the cold surface is made of terahertz absorber cooled by the group consisting of liquid-helium dewars and cryogenic coolers.

62. The method according to claim 58 further comprising focusing the field-of-view of the spectrometer onto the cold surface.

63. The method according to claim 58 further comprising splitting the emissions into a plurality of detection channels for detecting a plurality of frequency bands.

64. The method according to claim 58 wherein the terahertz frequency band includes microwave, millimeter wave and sub-millimeter wave frequency bands.

65. The method according to claim 58 wherein the sample is selected from the group consisting of a liquid sample, a powder sample, an aerosol sample, a vapor sample, a gas sample, chemical agents, biological agents, industrial chemicals, toxins, drugs, fungi, pollens and explosives.